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Poststreptococcal glomerulonephritis with pulmonary edema presenting as respiratory distress

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Abstract Acute poststreptococcal glomerulonephritis (PSGN) is characterized by an abrupt onset of edema, hypertension, and hematuria. Although the association of pulmonary edema with acute glomerulonephritis has been established, it is uncommon for children with PSGN to present with respiratory distress due to pulmonary edema. We encountered six such patients, aged 6–10 years, during a 10-month period. The demographic data, clinical manifestations, laboratory data, radiographic pictures, and clinical courses were collected. All patients presented to the primary pediatricians with dyspnea and alveolar infiltrates with bilateral pleural effusions on plain chest radiographs that were misinterpreted as pneumonia initially. The diagnosis of PSGN was delayed until the awareness of the presence of pulmonary edema complicating PSGN. Subsequent urinalysis and blood pressure measurement all showed microscopic hematuria and hypertension. Elevated serum antistreptolysin O titers and depressed serum complement C3

levels confirmed the diagnosis of PSGN. Two patients progressed to respiratory failure because of a delayed diagnosis of PSGN. All patients recovered without sequelae following appropriate diuresis and antihypertensive therapy. We conclude that in preschool and school-age children who present with dyspneic respirations and a chest radiograph showing radiographic features of pulmonary edema, proper evaluation including blood pressure recording and urinalysis should be performed immediately. Prompt diagnosis and early therapy of PSGN may avoid mortality and unnecessary therapeutic intervention.

Keywords Poststreptococcal glomerulonephritis · Pulmonary edema · Respiratory distress

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Introduction

Acute poststreptococcal glomerulonephritis (PSGN) is the most common form of postinfectious glomerulonephritis in children and usually follows pharyngitis or pyogenic skin infections [1, 2]. Gross hematuria, edema, and hypertension are the classic manifestations [3]. Rarely, potentially life-threatening complication of pulmonary edema can occur and require specific aggressive medical therapy [4]. Although the association of pulmonary edema with acute glomerulonephritis has been established [4], it is perhaps less well recognized that the pulmonary manifestations may be the dominant presentation and lead to a misdiagnosis. In this report, we try to delineate the diagnostic challenge and the characteristics of six such patients to make a prompt diagnosis.

Patients and methods

This study was conducted retrospectively by chart review of six children who had PSGN, presented with respiratory distress due to pulmonary edema, and were admitted to Chang Gung Children's Hospital in northern Taiwan from August 2001 to May 2002. Another 16 individuals with PSGN, who presented with reddish-brown

Table 1 The clinical and radiographic features of six pediatric patients with poststreptococcal glomerulonephritis and pulmonary edema (SOB shortness of breath, BP blood pressure, UA urinalysis, ASO antistreptolysin O, GAS Ag group A β -streptococcus antigen, CT cardiothoracic)

Patient	Age/sex	Presenting complaints	Initial diagnosis	Laboratory abnormalities		Chest roentgenogram findings		Therapy
				BP (mmHg)	Serology/UA	CT ratio (acute/convalescent)	Lung parenchyma (interstitial edema/alveolar infiltrates)	
1	6 years/M	Fever, SOB, cough, sore throat, mild peripheral edema	Pneumonia	134/92	ASO \uparrow , C ₃ \downarrow	0.54/0.49	+/+	Antibiotics, diuretics
2	10 years/M	Fever, SOB, cough, sore throat, mild peripheral edema	Nephrotic syndrome Pneumonia	128/91	Microscopic hematuria ASO \uparrow , C ₃ \downarrow	0.53/0.51	+/+	Antibiotics, diuretics
3	7 years/F	Fever, SOB, cough, hemoptysis, mild peripheral edema	Nephrotic syndrome Right lung pneumonia	145/101	GAS Ag (+) Microscopic hematuria ASO \uparrow , C ₃ \downarrow	0.53/0.49	+/+	Antibiotics, diuretics
4	8 years/M	Fever, SOB, cough	Pneumonia	148/98	Microscopic hematuria ASO \uparrow , C ₃ \downarrow Microscopic hematuria	0.62/0.49	-/+	Antibiotics, diuretics Chest tube insertion Respiratory failure with intubation Antibiotics, diuretics
5	6 years/M	SOB, abdominal pain, mild peripheral edema	Pneumonia Nephrotic syndrome	148/93	ASO \uparrow , C ₃ \downarrow , GAS Ag (+) Microscopic hematuria	0.60/0.47	-/+	Antibiotics, diuretics
6	10 years/M	Fever, SOB, cough, sore throat	Pneumonia	160/95	ASO \uparrow , C ₃ \downarrow Microscopic hematuria	0.57/0.50	+/+	Antibiotics, diuretics Respiratory failure with intubation

urine, were seen during this period. PSGN was diagnosed by history, physical findings, urinalysis, renal function, and serological tests including C3 concentration and antistreptolysin O (ASO) titers. Hypertension was defined as systolic and/or diastolic blood pressure values exceeding the 95th percentile for age and sex. Hematuria was defined by the presence of red blood cells greater than 10 cells per high-power field in centrifuged urine. Proteinuria was detected by the dipstick test as exceeding +2 (>100 mg/dl). ASO titers and C3 and C4 concentrations in serum were measured by radioimmunoassay. Plain chest radiographs were reviewed by a pediatric radiologist and evaluated for the presence of cardiomegaly, pulmonary blood volume, septal thickening, and/or pleural effusions. A cardiothoracic (CT) ratio of 0.55 or greater on a standard upright posteroanterior film was regarded as cardiomegaly. Relevant information pertaining to patient demographics, clinical presentation, preceding illness, laboratory results, plain chest radiographs, clinical course, and outcome were collected and analyzed.

Results

There were five boys and one girl in this study; the ages ranged from 6 to 10 years (mean 7.8 years). A history of previous upper respiratory tract infection was identified in five patients; patients 2 and 5 had streptococcal pharyngitis and were diagnosed by positive rapid streptococcal antigen test. The clinical features of the six patients with PSGN are presented in Table 1. All patients presented with dyspneic respirations (6/6) followed by low-grade fever (5/6), cough (5/6), and mild peripheral edema (4/6). Blood pressure measurement and urinalysis were not performed routinely on admission until the association of pulmonary edema with PSGN was suspected. Once examined, hypertension, mild proteinuria (no more than +2), and microscopic hematuria were found in all six patients. Patient 6 had high blood pressure exceeding 160/95 mmHg that was complicated by seizures and disturbance of consciousness.

Depressed levels of serum C3 (range 15.5–33.8 mg/dl, normal 73–134 mg/dl) and elevated ASO titers (range 431–917 IU/ml, normal <200 IU/ml) confirmed the diagnosis of PSGN in all patients. Reduced serum albumin levels (range 2.6–3.8 g/dl, normal 4.0–5.3 g/dl) were seen in all patients. Serum levels of cholesterol and triglyceride were measured in patients 1, 2, and 5, and no evidence of hyperlipidemia was found. Elevated serum creatinine (range 0.8–1.3 mg/dl, normal 0.3–0.7 mg/dl) and normal blood urea nitrogen levels were seen in all patients. Hemoglobin levels (range 9.2–10.9 g/dl) showed no evidence of hemoconcentration. Decreased urine output and body weight gain were evident in all patients. Iatrogenic fluid overload was excluded by records of fluid input and output meticulously. Patients 3, 4, and 6 had a two-dimensional echocardiographic examination and the results were normal. Renal ultrasound examinations showed increased renal echogenicity without structural abnormality in all patients.

Plain chest radiographs were performed before intubation and all excluded iatrogenic fluid overload. Compared with the convalescent stage, all patients had cardiomegaly and radiographic features of pulmonary edema



Fig. 1 A posteroanterior chest film of patient 2 on admission showed extensive alveolar air space infiltrates on both lungs. Cardiomegaly, pulmonary vascular congestion, and bilateral pleural effusions were also seen

(Fig. 1). Alveolar infiltrates with bilateral pleural effusions was the predominant pattern of pulmonary edema, which was usually misinterpreted as pneumonia at presentation.

Initially, all patients received β -lactam antibiotic therapy under a presumptive diagnosis of pneumonia. A diagnosis of PSGN-associated pulmonary edema was not entertained until the 2nd, 3rd, and 12th days after admission in patients 1, 6, and 4, respectively. Patients 4 and 6 required mechanical ventilation in an intensive care unit due to progressive dyspnea and respiratory failure. The chest radiograph of patient 4 was misinterpreted as parapneumonic effusion and he underwent a thorocostomy tube insertion for drainage. Pulmonary alveolar infiltrates resolved within 3 days and blood pressure normalized within 10 days following appropriate diuresis and antihypertensive therapy in all patients. Microscopic hematuria resolved within 6 months in five patients. All children recovered without renal function impairment or neurological sequelae.

Discussion

The wide-spectrum presentation of PSGN always poses a diagnostic challenge to primary care pediatricians. Gross hematuria, peripheral edema, and hypertension are the first clues to diagnosis of PSGN [1, 2, 3]. However, microscopic hematuria and non-specific symptoms such as low-grade fever, cough, sore throat, or abdominal pain may be neglected by the physicians who first see these patients. Dyspnea, the unusual but severe symptom in patients with PSGN, was evident in all six patients in this study, either as a presenting symptom or suddenly developing during hospitalization. A delayed diagnosis of PSGN in such instances may progress to respiratory failure and lead to inappropriate therapeutic intervention

such as thoracostomy. Early awareness of respiratory distress associated with pulmonary edema in children with PSGN can help clarify the diagnosis, resulting in a more timely treatment. However, it is heavily reliant on the clinical awareness and the recognition of radiographic pictures of pulmonary edema. In this series, the diagnosis of PSGN associated with pulmonary edema was not established in three patients until 2–12 days after hospitalization. A diagnosis of PSGN was initially not considered, simply because the physicians were unfamiliar with the presence of respiratory distress in patients with PSGN or they were unaware of the radiographic findings of pulmonary edema, and misinterpreted the radiographs as pneumonia at presentation.

The chest radiographic findings of pulmonary edema in patients with acute glomerulonephritis have been well established. In a previous report of 104 patients with acute glomerulonephritis, cardiomegaly was present in two-thirds of patients and alveolar pulmonary edema was evident in 16% [4]. In our series, cardiomegaly (CT ratio ≥ 0.55) in the acute stage was seen in three patients (50%), but when compared with the cardiac size in the convalescent stage, cardiomegaly was also evident in the other three patients. In addition, bilateral pleural effusions were universally seen in these patients. These findings suggested either volume overload or cardiac insult [5]. However, cardiogenic pulmonary edema was unlikely because the ventricular function was normal upon echocardiographic examination. With the findings of pulmonary alveolar infiltrates and bilateral pleural effusions on plain chest radiographs, and shortness of breath, all six patients were treated as pneumonia initially. It must be emphasized that the differential diagnosis of pulmonary alveolar infiltrates should include infections, hemorrhage, or edema. In particular, the presence of bilateral pleural effusions, increased CT ratio, and prominent septal thickening should have alerted the clinician that this is an unlikely presentation for acute bacterial pneumonia.

The prognosis of acute PSGN in children has been excellent when treated adequately [6], but early mortality may be as high as 25% in elderly patients who have complications of pulmonary edema [7]. The treatment of pulmonary edema complicating PSGN is mainly appropriate diuresis [8, 9] and all patients survived without sequelae in this study. Prompt diagnosis of PSGN and early therapy of pulmonary edema may avoid possible mortality and decrease unnecessary therapeutic intervention such as endotracheal intubation or thoracostomy in certain instances.

In our series, the presentation of pulmonary edema complicating an underlying glomerular disease of PSGN is consistent with the well-described term pulmonary renal syndrome, which indicates the coexistence of pul-

monary and glomerular renal disease [10]. In childhood, pulmonary renal syndromes present as rare but serious medical emergencies as in our series. Since there are many causes of this syndrome and early diagnosis is crucial, we strongly recommend that proper evaluation, including urinalysis and blood pressure recording, should be an essential part of the work-up in any severely ill patient who presents with pulmonary edema to investigate the possible coexistence of a glomerular renal disease. Similarly, in children with a glomerular renal disease such as PSGN, who have sudden onset of dyspneic respirations, a chest radiograph should be performed to make an early diagnosis of the potentially life-threatening complication of pulmonary edema.

In conclusion, in preschool and school-age children who present with dyspneic respirations and a chest radiograph showing cardiac enlargement, bilateral pleural effusions and alveolar infiltrates, the radiographic features of pulmonary edema should be recognized. Proper evaluation, including blood pressure recording and urinalysis, should be performed immediately to investigate the coexistence of glomerular renal disease. Prompt diagnosis of PSGN and early therapy of pulmonary edema may avoid mortality and unnecessary therapeutic intervention.

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